

**REMARKS**

This amendment responds to an Office Action dated June 5, 2002, in the above-identified patent application. Claims 1-20 were filed in the original application.

By this response, Applicants have cancelled claims 1-7 and 11, amended claims 8, 10, 12 and 14, and added new claims 21-25. Claims 8-10 and 12-25 are under consideration in the application, of which claims 8, 14 and 21 are in independent form. No claims are currently allowed. This Response is being filed within four months of the Office Action outstanding. A Request for a one month time extension is submitted herewith. Applicants request the fee for the one month time extension be withdrawn from Applicants' Deposit Account No. 19-1457. No additional claim fees are required.

In the Office Action dated June 5, 2002, the Examiner noted that claims 1-7 have been withdrawn from consideration. By this Response, Applicants have cancelled claims 1-7.

In the Office Action dated June 5, 2002, the Examiner rejected claims 8-14, 16-18 and 20 under 35 U.S.C.

102(e) as being allegedly anticipated by Lopatin et al.  
(U.S. Pat. No. 6,368,954).

By this Response Applicants have amended independent claim 8 to recite "providing a third chemical species in said reactant chamber; and providing a fourth chemical species in said reactant chamber, wherein said third and fourth chemical species react to deposit a second layer of said barrier metal thin film of a second metal nitride on said first layer by atomic layer chemical vapor deposition, wherein said second metal nitride is different from said first metal nitride." By this Response Applicants have also amended independent claim 14 to recite "wherein said first metal nitride is different from said second metal nitride." Support for these amendments are found in Applicants' specification as filed at page 4, line 13 through page 5, line 3:

"For example, alternating Tantalum Nitride/Silicon Nitride (TaN/SiN), Tantalum Nitride/Titanium Nitride (TaN/TiN) and Titanium Nitride/Silicon Nitride (TiN/SiN) thin films, or their combinations, are relatively easy to deposit using the ALCVD technology of the present invention. The entire film stack thickness typically is less than 100 Angstroms (100A), preferably less than 60A, and can be as low as fifty Angstroms (50 A), and can exhibit superior barrier film properties.

In particular, a direct application for ALCVD barrier metal films deposited by the current invention is the multi-layered TaN/TiN film stack. TaN films

have better barrier properties when compared to TiN but often exhibit poor adhesion for the subsequently deposited Copper (Cu) film, when compared to adhesion characteristics of TiN films. Single layer films also form grain structures that permit some diffusion along the grain boundaries. Accordingly a single layer film of either TaN or TiN has disadvantages. The TaN/TiN multi-layer stack, therefore, would be an attractive alternative for a barrier film for Cu metallization."

Lopatin et al. do not teach or suggest different layers of a barrier metal thin film being comprised of different metal nitrides. Moreover, Lopatin do not even address the benefits of such a multi-layered structure comprising alternating layers of different metal nitrides, as recited by Applicants in their claims as amended. Accordingly, Applicants believe that independent claims 8 and 14, and corresponding dependent claims 9-13, 16-18 and 20 are in condition for allowance and Applicants respectfully request the Examiner to withdraw the rejection of these claims under 35 U.S.C. 102(e).

In the Office Action dated June 5, 2002, the Examiner rejected claims 8-18 and 20 under 35 U.S.C. 102(e) as being allegedly anticipated by Satta et al. (U.S. Pat. No. 6,391,785). Satta et al. do not teach or suggest different layers of a barrier metal thin film being comprised of different metal nitrides. Moreover, Satta do

not even address the benefits of such a multi-layered structure comprising alternating layers of different metal nitrides, as recited by Applicants in their claims as amended. Accordingly, for the reasons discussed above, Applicants believe that independent claims 8 and 14, and corresponding dependent claims 9-13, 15-18 and 20 are in condition for allowance and Applicants respectfully request the Examiner to withdraw the rejection of these claims under 35 U.S.C. 102(e).

In the Office Action dated June 5, 2002, the Examiner rejected claims 15 and 19 under 35 U.S.C. 103(a) as being allegedly anticipated by Lopatin et al. Claims 15 and 19 are dependent on independent claim 14 as amended. Accordingly, for the reasons discussed above, Applicants believe that dependent claims 15 and 19 are in condition for allowance and Applicants respectfully request the Examiner to withdraw the rejection of these claims under 35 U.S.C. 103(a).

In the Office Action dated June 5, 2002, the Examiner rejected claim 19 under 35 U.S.C. 103(a) as being allegedly anticipated by Satta et al. Claim 19 is dependent on independent claim 14 as amended. Accordingly, for the reasons discussed above, Applicants believe that dependent

claim 19 is in condition for allowance and Applicants respectfully request the Examiner to withdraw the rejection of this claim under 35 U.S.C. 103(a).

By this Response Applicants have added new claims 21-25. Independent claim 21 recites "depositing a first layer of a first metal nitride on said substrate by atomic layer chemical vapor deposition; and depositing a second layer of a second metal nitride on said first layer by atomic layer chemical vapor deposition; wherein said first metal nitride is different from said second metal nitride."

Claims 22-25 are dependent on independent claims 21. For the reasons listed above, Applicants believe new claims 21-25 are in condition for allowance and Applicants respectfully request the same.

Applicants respectfully request entry of this Amendment and consideration of the application as amended.

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Respectfully submitted,

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